this time probably eight-tenths obscured with heavy cumulus Perfect Liquid and a Viscous Liquid, which displays power and stratus clouds; the round lumpy cumulus clouds were underneath the more compact stratus formation. No whirling motion was observed, and no attention would likely have been paid the storm, had it not been for the intense inky blackness of the clouds and their steady progression against the wind which was blowing at the rate of about 14 miles per hour from the southeast; the clouds were moving directly from the northwest and very rapidly.

A heavy downpour of rain began at 12:06 p. m., with sky now entirely overcast, but the wind still from south to south-At 12:16 p.m. the wind suddenly shifted from south to northwest, and increased in velocity from 12 to 50 miles per hour in less than five minutes, reaching a maximum velocity of 63 miles per hour, and an extreme velocity of 75 miles per hour at about 12:30 p.m. The cable connecting the anemometer to the self-register was broken at 1 p. m., and no record was obtained until after 4 p. m., but the gale continued until about 2 p. m., with but slightly diminished intensity. By 3 p. m., however, the wind had fallen to 8 miles per hour, and had changed to the southeast.

The rain literally came down in sheets, and the storm probably comes as near to reaching the dignity of a cloud-burst as any rainfall ever observed here. There was no preliminary sprinkle as a curtain-raiser, but the curtain was pulled aside and the rain literally poured; 3.02 inches fell from 12:06 to 12:45 p.m., and the sky became so dark that gas

was lighted in churches and offices.

The following barometer readings will show that the fluctuations in the atmospheric pressure were larger than ordinary:

Time.	Tempera- ture.	Barome- ter.	Time.	Tempera- ture.	Barome- ter.
12:05 p. m	81.0	Inches, 28,646 28,656 28,650	12:30 p. m 12:45 p. m	80.0 80.0	Inches. 28.528 28.640

At about 12:30 p. m. a heavy trap door on the roof of the Government building was thrown open with sufficient force to break a new quarter-inch cord; the windows and doors were all closed at the time, showing very strong outward pressure. The windows of two buildings near this one had their sashes blown out at about the same time.

The electrical display was vivid but not more than ordinarily severe. The storm was entirely local in extent, although from the amount of rain and the time the gale lasted it would appear impossible that the stupendous energy could have been confined to a prescribed locality.

PROF. P. E. DOUDNA.

By F. Cajori.

Meteorology has lost a promising investigator in the person of Pearl Eugene Doudna, who at the time of his death held the position of assistant professor of mathematics in Colorado College. Mr. Doudna died at Colorado Springs on the 6th of last January. For five years he had been in charge of the voluntary meteorological station maintained by Colorado College. During the last few months of his life he was engaged in arranging for publication the local meteorological data, reaching back over many years. With the help of a few students the task was completed the day after the beginning of his last illness.

Mr. Doudna published, in Vols. VII and VIII of Colorado College Studies, a paper entitled Equations of Motion of a by 2 p. m. only small broken patches of cloud remained.

in original research and is well worthy of examination on

the part of specialist on this subject.

Mr. Doudna was born in Richland County, Wis., in 1868. He graduated from the University of Wisconsin in 1894 and was made fellow in mathematics at his alma mater. In 1895 a serious illness compelled him to resign. He went to Colorado Springs and became connected with Colorado College. For five years he taught mathematics with signal success. He interested several students in meteorology, and it was his plan during the coming year to offer a regular course on this subject.

HALO AT DETROIT, MICH., MAY, 1900.

By JOHN K. HOOPER, Observer Weather Bureau.

An optical phenomenon which was observed at Detroit, Mich., the morning of May 19, 1900, is deemed sufficiently interesting to meteorologists generally to record at length, because of its remarkable distinctness, and the beauty and novelty of its design. While halos of different radii are common at Detroit, optical phenomena of this magnitude and brilliancy are of rare occurrence.

It brought forth numerous startling theories as to its origin and forecasts of events to occur, and proves again that medieval superstitions are not outgrown; it seemed as if all who saw it besieged the Weather Bureau station with inquiries, the telephone bell ringing continually during the exhibition.

The phenomenon was first noted at 11:15 a.m., seventy-It then consisted of two complete cirfifth meridian time. cles of 22° and 45° radii around the sun. The former was of vivid brightness, red on the inside, changing to yellowish white at the outer edge; it was doubled also, the circles but a fraction of a degree apart, yet showing the separation plainly, intersecting each other at points directly above and below the sun, bearings north-northwest—south-southeast. The circle of 45°, which contained all the colors of the spectrum, though the red predominated, was not as bright.

Soon after the phenomenon was first observed the latter grew faint at the point immediately above the sun; it faded evenly along both the east and west portions, and at 11:30 a. m., when about 90°, had disappeared, a white circle, with a radius of 22°, became visible, having for its center the upper intersection of the double inner circles, cutting those and passing through the sun but forming no parhelia.

The maximum was reached at 12 noon. At 12:15 p. m., when more of the circle of 45° had faded, there appeared three white segments, the apparent radius of each 45° convexly in contact with the inner halo, one bearing directly north, the others east and west, and the first forming a faint parhelion at its junction with that circle. At this time the complete white circle had faded materially. By 1 p. m. the white portions of the design had vanished, as had nearly all of the 45° halo, except a small arc directly under the sun. From this time the balance of the design grew indistinct, and by 1:30 p. m. all but a faint partial halo of 22° had disappeared. At 2 p. m. it had vanished altogether.

The sunrise was obscured by alto-stratus cloud formations, and this type prevailed during the morning. At 10:30 a.m. a huge mass of alto-stratus was noted approaching from the west, and by 11 a.m. the edge of the mass was in the vicinity of the sun. The clouds were decidedly grayish in color and smooth in texture, overspreading the sky toward the west. Much of the gray color had disappeared by 12:30 p. m., and the smoothness was less noticeable from that time. By 1 p. m. the mass showed signs of disintegration, and at 1:30 p. m. large patches of blue sky were in view in all directions;

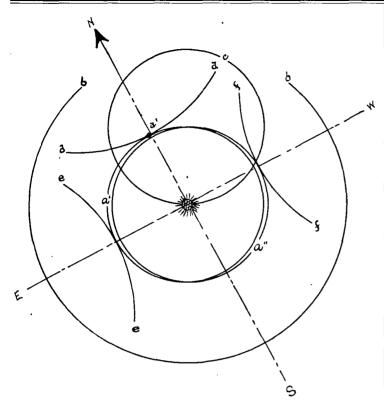


Fig. 2.—a' a'' Complete circles of 22°, with intensely bright prismatic colors (red on inside). The space about the sun encircled by these halos was darkened to a considerable degree.

bb A portion of a circle of 45°, also in prismatic colors (red on inside), though not so bright.

c A complete circle, white in color, having for its center the upper

intersection of a' a" and passing through the sun. and A segment, white in color, apparent radius 45°, which joined a'', showing a faint parhelion (a') at junction.

of Similar segments to the foregoing, without parhelia.

The radii were estimated without instruments; the bearing was taken by means of the direction arms of the station anemoscope.

LAKE LEVELS AND WIND PHENOMENA.1 By ALFRED J. HENRY, Professor of Meteorology.

Through the courtesy of the officials of the Engineer Corps, United States Army, in charge of the survey and improvement of the Great Lakes, we have been furnished with a continuous record of the fluctuations in lake level for several months past, at Amherstburg, Ontario, mouth of the Detroit River, and Buffalo Harbor, Lake Erie. These rio, mouth of the Detroit River, and Buffalo Harbor, Lake Erie. records, in conjunction with the continuous records of wind direction and velocity and atmospheric pressure made at the Weather Bureau offices in Detroit and Buffalo, furnish the material for a study of the mechanical effect of the wind in raising and lowering the level of the lake at the points above named.

It has been known for some years that general winds, as distinguished from local winds, blowing parallel to the longer axis of the main body of the lake, have a tendency to heap up the water at the end of the lake toward which they blow, and to depress it at the opposite end. Owing to the convergence of the shore lines at Buffalo the heaping up of the waters in that harbor, under the influence of a southwesterly wind, becomes a serious menace to the safety of wharf and dock prop-Likewise, owing to the shoal water at either end of the lake, a decrease in the available depth in the harbors and channels produces vexatious delays and frequent groundings.

As a first attempt to correlate atmospheric phenomena and fluctua-

tions of lake level, we have platted the data of wind direction and velocity at the Weather Bureau stations of Buffalo and Detroit, and the fluctuations of lake level as registered by the gages maintained by the Engineer Corps at Buffalo and Amherstburg, respectively, for March, The record for the entire month can not be reproduced on this chart, but we present in the accompanying diagrams the curves for March 4 to 10, and from noon of March 22 to noon of March 29. The first diagram (Fig. 3) illustrates the fluctuations in lake level consequent upon the passage of a storm moving from the Mississippi Valley northeasterly across the Lake region. It will be noticed, having reference particularly to that portion of the diagram included between 4 a.m. of the 5th and 4 a. m. of the 7th, that at Amherstburg the water first rose then fell and rose again, and that the oscillations at Buffalo were almost the exact converse of those at Amherstburg.

The fall in level at Buffalo and the corresponding rise at Amherstburg are due, as is generally known, to the northeasterly winds in front of the advancing storm. As the storm center passes Amherstburg, let us say, the wind shifts or backs, as the case may be, to a westerly quarter; likewise, as the storm center advances successively from point to point between Amherstburg and Buffalo, the winds along the line of movement of the storm center also change direction from an easterly to a westerly quarter. When the shift of wind occurs the water is above the mean level at the western end of the lake and below at the opposite end. The new impulse given to the lake waters by the westerly winds generates a second oscillation in a direction contrary to the first, viz, from west to east, and the cycle of changes is completed when the water finally returns to the level it had before the advent of the The amplitude of the oscillations may reach an extreme value of 6 or 7 feet, but, in general, it is considerably less.

The records thus far obtained show that the oscillations do not occur with all storms, and that a given wind velocity does not necessarily

produce a corresponding change in water level.

The period of the oscillation depends largely upon the time the easterly winds prevail, since there will be no reflex movement of the water until the wind changes to a westerly quarter. When this change takes place the concluding phase of the oscillations seems to occupy from twelve to sixteen hours, notwithstanding the fact that the wind may

persist at a high velocity.

The second diagram (Fig. 4) is in some respects similar to the first. It, too, illustrates the passage of a storm, but with this important difference, viz, the center of the storm passed due east across Lake Erie and the wind backed to the northwest instead of shifting to the southwest, as in the first storm. The velocity of the wind was not nearly so high as in the first case. The northeasterly winds of the second storm caused an elevation of the waters at Amherstburg and a depression at Buffalo, as in the first storm, but here the similarity of the phenomena ends. The impulse given the water by the northwest winds seems to have created a transverse rather than a longitudinal oscillation; that is to say, an oscillation across the lake from the Canadian to the American shore, instead of lengthwise of the lake, as happens with northeasterly winds. It will also be noticed that the period of the oscillations from about 4 p. m. of the 26th to noon of the 27th is shorter than that of the succeeding days and at other times when longitudinal oscillations prevail, as might be expected. The oscillations from 6 p. m. of the 27th to noon of the 29th appear to be characteristic of fair weather, with light to moderate winds. The synchronism of the times of high water at Amherstburg and low water at Buffalo, and vice versa, is almost perfect. The period of oscillation is likewise fairly constant, ranging from six to eight hours for a half oscillation and from twelve to sixteen hours for a whole oscillation. The computed time of a whole oscillation, assuming the lake to have a mean depth of 50 feet, is, roughly speaking, seventeen hours.

While the information on the subject is as yet too fragmentary to admit of drawing trustworthy conclusions, this much seems to be apparent: The oscillations are stationary rather than progressive. A wave of water is not propagated, in the ordinary sense of that word, from one end of the lake to the other, but the whole lake oscillates about a pivotal or nodal line, which, in the case of longitudinal oscillations, may be said to cross the lake about the longitude of Fairport, Ohio. Although we have no instrumental evidence of the fact, it may be assumed that, as in the case of similar oscillations in other land-locked bodies of water, the oscillations at the nodal line are zero, increasing to a maximum at the respective ends of the lake. Dangerous currents in midlake are not likely to be engendered by these temporary

oscillations

It is within the range of probability that the occurrence of the more pronounced oscillations can be forecast by the Weather Bureau at no distant period.

¹Reprinted from the Lake Chart for July, 1900.